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Amateur or professional? A new look at 19th century patentees in Norway

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AMATEUR OR PROFESSIONAL? A NEW LOOK AT 19TH CENTURY PATENTEES IN NORWAY

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SUMMARY

The paper analyses Norwegian 19th century patentees. A special focus is on the affiliation or relationship of the patentees to the manufacturing industries, business and the wider economy. A main question is whether the inventors were what might be called 'amateurs' working independently, or 'professionals' working closer to firms or institutions. A main finding is that even the individual patentees, that comprised the majority of all patentees, had strong associations with industry, and the distinction between 'professionals' and 'amateurs' is not all that useful.

KEYWORDS

Industrial breakthrough; Norway; patentees; patents; professional inventors

JEL classification: N63, N73, O31, O34

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AMATEUR OR PROFESSIONAL? A NEW LOOK AT 19TH CENTURY PATENTEES IN NORWAY[1]

1. Introduction

In an attempt to explain the usefulness of information from patents (patent data and patent statistics) to shed light on innovation, it is necessary to look into and study the patents in detail. It is necessary to know who the patentees were and thus get a deeper understanding of the relationship between the patents and their environment – the actual economy. One important relationship is between the patent (and the patentee) on the one hand and the invention (inventor), innovation (innovator, entrepreneur) and the technological and economic changes at large. Another relationship is between patentees and companies, institutions, industries and government. In this context, one question is whether the inventors were what we might call 'amateurs' working independently, or 'professionals' working closer to firms or institutions? It is still a challenge to find out more about to what extent patents were mere curiosities and to what extent they led to important changes and affected economic and technological development. To study the relationships between amateurs and professionals represents at least one way to assess the possible economic and / or technological impact of patents.

It has traditionally been assumed that the technological development that historically used to be initiated by individual amateur inventors, increasingly originated within companies as institutionalized R&D – in professional environments.[2] This development has also been unveiled in patent data from Schmookler and onwards.[3]

There has also been a much more recent interest in research on the early development of the patent system in several countries. The research has focused on the development of the system itself, but also on the relationship between patentees and inventors and about the increasing professionalization.[4] Most recently, Nicholas has studied the role of the so-called independent inventor from the late 19th century in several countries (the US, UK and Japan).[5]

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[1] I have received helpful comments from Liam Brunt and Stig Tenold.

[2] S.C. Gilfillan, *The Sociology of Invention*, Chicago 1935, p. 31 on the general principle.

[3] J. Schmookler, "Inventors past and present", *Review of Economics and Statistics*, vol. 39, 3-1957; see especially the Appendix, W. Anderson et.al., *Patents and Progress. The Sources and Impact of Advancing Technology*, Homewood, Ill. 1965, p. 238, C.T. Taylor and Z.A. Silberston, *The Economic Impact of the Patent System*, London 1973, p. 314.

[4] H.I. Dutton, *The Patent System and Inventive Activity during the Industrial Revolution 1750-1852*, Manchester (Manchester UP), 1984, K.L. Sokoloff and B. Zorina Khan, "The Democratization of Invention During Early Industrialization: Evidence from the United States, 1790-1846", *The Journal of Economic History*, Vol. 50, 1990,

How can we distinguish between amateur and professional inventors and patentees? One obvious distinction is between on the one hand patents applied for and granted to individuals, and on the other hand to companies / firms. However, the patents granted to individuals may obviously also have clear economic motives, and the inventors may have a close relation to industry or commerce. Nicholas' analysis shows in fact that the quality (as indicated by citations) of the individual or independent patents where typically higher than patents that originated within firms. This obviously question if the distinction between individual and firm patents will also distinguish between the amateurs and the professionals.[6]

In analyzing such issues in the context of the British Industrial Revolution, Dutton defined four criteria that had to be met if the inventors should be considered as 'economic men operating in what might be termed an invention industry':[7] (1) Most inventors would obtain patent protection for their ideas, (2) a considerable proportion of the inventors would hold several patents, (3) the inventors would invent (and patent) in different industries to diversify their inventive portfolio, and (4) patented inventions would be traded. Dutton used the phrase 'quasi-professional inventor' of these multiple patentees.

This paper will study Norwegian 19th century patentees using a sample of data from our own earlier research, as well as new studies of Norwegian patent records.[8] A special focus will be on the affiliation or relationship of the patentees to the wider economy. We will especially address the relationships between individual and company patentees and between amateur and professional

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C. MacLeod*, Inventing the Industrial Revolution. The English Patent System, 1660-1800*, Cambridge (Cambridge UP) 1988. Another direction of research has been about inventions without patenting; see P. Moser, "Why Don't Inventors Patent?", *NBER Working Paper*, 13-2007. There has also been a recent interest in other incentives to inventors like awards, medals and prizes; see L. Brunt, J. Lerner and T. Nicholas, "Inducement Prizes and Innovation", *Discussion Paper*, The Norwegian School of Economics, SAM 25 2011. Such issues will not be dealt with here.

[5] T. Nicholas, "The Role of Independent Invention in U.S. Technological Development, 1880-1930", *The Journal of Economic History*, Vol. 70, No. 1, 2010 and s.a. "Independent invention during the rise of corporate economy in Britain and Japan", *Economic History Review*, vol. 64, No. 2, 2011.

[6] Citations were not included in Norwegian patents at the time, so this particular approach could not be pursued.

[7] Dutton, p. 108ff.

[8] B.L. Basberg, *Patenter og teknologisk endring i Norge, 1840-1980. En metodediskusjon om patentdata anvendt som teknologi-indikator*, Bergen (unpublished dr.thesis NHH), 1984. Chapter 5.3. contains a first attempt from which this paper derives.

inventors. We will investigate patentees and patents, and how they may shed light on our main questions. We will, following Dutton, investigate the multiple patentees. We will in particular discuss how the patents were distributed across categories, and ask whether a concentration or a diversification of the patent portfolio is the most likely strategy for the professional inventor.

The question about the extent to which inventors patent, will not be dealt with here. Furthermore, we will not discuss trading of patented inventions. Both questions are nevertheless very interesting and important, and deserve to be analyzed in future research.

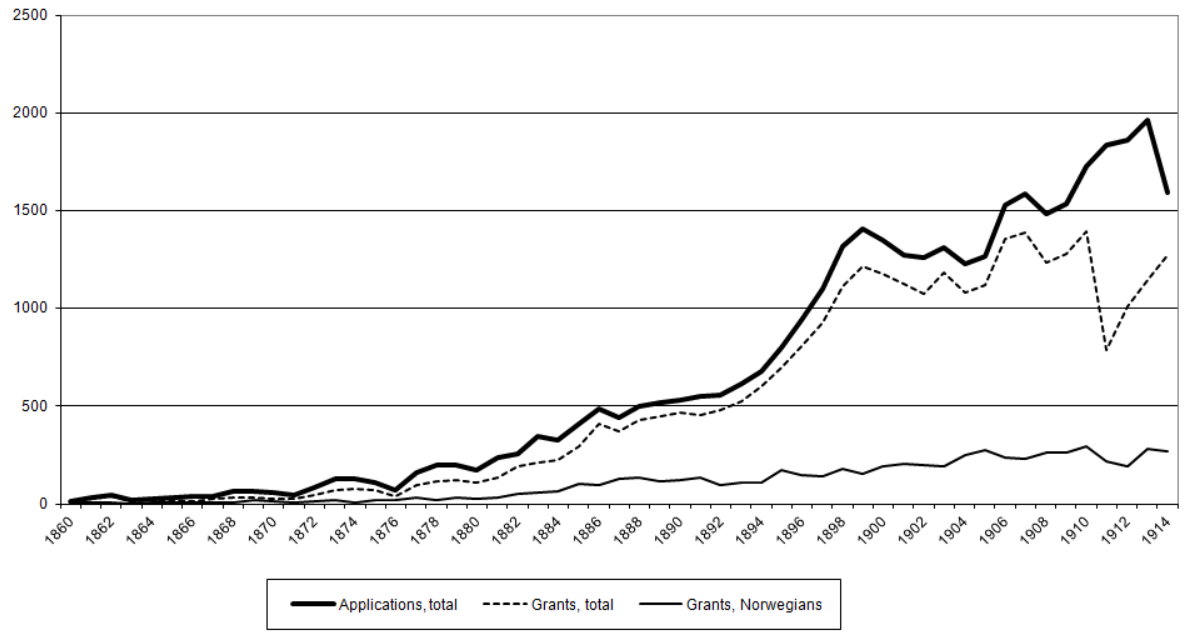
2. The 19th century patent system in Norway

The Norwegian patent system was formally established in 1839 after a number of years with discussions of how it should be organized. For many years the interest in the patent institution and in patenting was moderate. A first real increase in patenting occurred only in the 1870s and 80s – much later than in many other European countries.

In earlier papers, the creation of this system in Norway and the development throughout the latter part of the 19th century, have been studied.[9] One question was how the patent system was considered by the government as part of the general modernization strategy at the time. Another one was the degree to which patenting activity seemed to be related to the general industrialization process of the country in the latter part of the 19th century. Both the development in the aggregate numbers of relevant patent statistics (applications, grants) and the relationship between Norwegians and foreigners were analyzed. Between 1839 and 1860 the annual number of applications was typically less than ten, and never reached more than 19 (in 1859). In Figure 1 aggregate numbers are displayed from 1860 to 1914. They clearly show that the patenting activity in Norway was still very moderate for many years, both patenting by foreigners and by Norwegian citizens.

[9] B.L. Basberg, "Creating a Patent System in the European Periphery: The Case of Norway, 1839-1860", *Scandinavian Economic History Review*, XLV, 2-1997 (pp. 142-158) and s.a., "Patenting and Early Industrialization in Norway, 1860-1914. Was there a Linkage?", *Scandinavian Economic History Review*, LVI, 1-2006 (pp. 4-21).

Figure 1: Patenting in Norway, 1860-1914



Source: Basberg (2006)

Before 1877 annual total applications were never more than 150. Over the years that followed, patenting was, as can be seen in Figure 1, increasing to more significant numbers.

What about patents with a foreign origin? During the very first years after 1840 there was little or no interest from abroad. But as the existence of the system became better known, the number of applications increased. Numbers stayed low, but the proportion of patents granted in Norway annually to foreign citizens increased gradually to typically around 80 percent around the turn of the century. It is clearly seen in Figure 1 that the patents granted to foreigners were responsible for the overall increase in grants in Norway. Grants to Norwegian citizens were quite modest throughout the entire pre WWI period – never reaching more than 300 annually.

The distribution on patent classes, technological areas and industries have also been analyzed earlier. Furthermore, the relationship between various groups of patentees; the so-called amateurs and professionals was also to some extent studied. However, this was not done on a true micro-level, by looking at the individual patentees. This will therefore be the main focus of the following analysis.

3. The patentees – who were they?

Aside from the actual patent documents (the applications and patent letters), there are various records of patents and patentees from the early years of the system in Norway. The most useful record is a list (a 'Register') of patentees and descriptions of the patents from the introduction of the system in 1839 to 1885 – when a new patent law was introduced.[10] Altogether 2290 patents are registered there. They have been the prime source of information in the following analysis. From 1886 patents in Norway were numbered from No. 1. A new register was published for the years 1886 to 1895, and from then on, annually. At the turn of the century, altogether 11,148 patents had been granted in Norway.

The first question that will be considered is about patentee characteristics. In an earlier work, 100 patents granted in Norway between 1840 and 1860 were categorized by technological areas.[11] There is incomplete information about their nationalities, but the estimated number of foreign patentees is 35. Only altogether five patents were filed in the names of companies: Siemens & Halske (2), Pascal & Co, Pelly & Co and Christiania Spiger- og Valtseværk. The two former were foreign companies from Germany and France (Lyon). Pelly & Co had the address of Borregaard, a large Norwegian estate that later gave the name to one of the country's largest companies. Pelly indeed owned Borregaard, but the company as well as its owner Sir John Henry Pelly, were British.[12] The final company was a fully Norwegian company, later to become a major manufacturer of nails in the Oslo area.

These first twenty years of patenting in Norway show that companies were insignificant as patentees. Taking the entire period 1840 to 1885 together, the picture does not change much. In Table 1 the patents are grouped according to the category of the patentee; whether he was an individual inventor, if two or more individuals were collaborating about the patent, or if the patentee was a company.

[10] *Register over norske patenter udferdigede indtil 1ste Januar 1886* (Register of Norwegian patents), Kristiania 1896.

[11] Basberg (1997), p. 154.

[12] A. Meidell (ed.), *Borregaard. The Kellner Partington Paper Pulp Co. Ltd. 1889-1939*, Oslo (Tanum) 1939, p. 65.

Table 1: Distribution of Norwegian patents, 1840-1885 according to type of patentees

Patentee:	*Total*	*%*
One individual	1835	81.6
Two or more individuals	265	11.8
A company	148	6.6

Source: *Register over norske patenter udferdigede indtil 1ste Januar 1886* (Register of Norwegian patents), Kristiania 1896.

Note: The total adds up to 2248, slightly lower than the 2290 that is the total included in the register. This may be caused by some double counting in the latter. There are also some differences between numbers published in various sources and lists. The number of patent grants between 1840 and 1885 published in Basberg (1984) based on various sources was 2184.

An overwhelming majority (81.6%) of the patentees had applied for and were granted patents on their own. Two or more individuals collaborating about a patent was rare (11.8%) and patents in the name of companies were rare (6.6%). If only patents in the name of companies are considered to belong to professional inventors, the dominance of amateurs was, indeed, apparent among early Norwegian patentees.

Whether the patentee was an individual or a company may indicate something about the importance of the patent. Another indication of the importance of the patentee is the number of patents they had. This is one of the criteria referred to by Dutton when defining the 'quasi-professional inventor'. Table 2 therefore shows the distribution of Norwegian patentees between 1840 and 1885 according to how many patents they held; two, three and four or more. The patentees are also distinguished as before, between individual patentees, patentees that were two or more individuals, and company-patentees.

Table 2: Distribution of patentees with more than one patent, 1840-1885

Patentee:	*Number of patents per patentee:*			
	2	*3*	*4 or more*	*%*
One individual	95	33	31	84.6
Two or more individuals	10	2	1	6.9
A company	12	4	0	8.5

Source: *Register over norske patenter udferdigede indtil 1ste Januar 1886* (Register of Norwegian patents), Kristiania 1896.

The distribution reveals a very clear picture. The vast majority of the patentees with more than one patent were individuals, single person patentees (84.6%). And a vast majority of the multiple patentees had two patents. One might assume that patents granted to two or more individuals or to companies would be responsible for more patents (3, 4 or more), but that was not the case. We can see that out of 39 patentees with three patents, 33 were individual patentees. Out of 32 patentees with four or more patents, 31 were individual patentees. The companies were slightly more active in multi-patenting (8.5%) compared to their proportion of the total patents (6.6%), but these are small differences.

It should be of interest to take a closer look at these patentees. The 32 patentees with four or more patents altogether held 179 patents; an average of 5.6 patents per patentee. 19 patentees were Norwegians, and they are listed in Appendix I. Some biographical notes are also included, and one is immediately struck by the presence of several familiar names from the Norwegian manufacturing industry at the time. At least to some degree they seem to reflect new, emerging industries that characterized the industrialization process in Norway in the second half of the nineteenth century. One such industry was the mechanical works and shipyards that grew up from the 1840s and 50s exploiting among others the new steam technology, and built ships, locomotives and machinery for other emerging industries. Jacob Smith Jarman (five patents), for example, was a co-founder of the Nyland mechanical work in 1854. The brothers Jens and Andreas Jensen together with Knud Dahl (four patents) (the only patent in this category in Table 2 granted to two or more individuals) founded another of those pioneer works; Myren Works. This is also where Henrik Chr. F. Størmer (four patents) spent part of his career. But he also founded several cellulose factories, another important branch of new Norwegian industries together with wood processing and paper. H.C.

Hansen (four patents) is another patentee who was a pioneer within this industry; co-founding an early wood processing factory in Skien and working at the Laugstol Brug. Anton Løvstad (six patents) was in charge of the building of the first sulfit cellulose plant in Norway, Vadretta in Skien in 1881. Then there were other industrial pioneers: C.C. Steenstrup (four patents) belonged to a well known family of industrialists, was working in the iron industry and the emerging mechanical industry, and was an inventor in a variety of areas.[13] Svend Foyn (five patents) founded an entirely new industry – 'modern' whaling.

The biographical notes in Appendix I are far from complete. They do, however, seem to suggest that inventors with an association to industrial firms have used the patent system from its earliest days in Norway. Although the patentees were individuals and not companies, they must indeed be considered as professional inventors. However, this is not to say that the patent records of the first decades were not dominated by the amateurs. This is also clearly reflected in the names that are listed in Appendix I that, of course, only shows the tip of the iceberg. The fact that we have no biographical information about several of the patentees may well indicate that they never made their way into the history books and encyclopedias. They were indeed amateurs.

The foreign patentees with more than four patents between 1840 and 1885 have also been analyzed in some detail (Appendix II). They also contain familiar names from invention- and industry history, reflecting that the patent system even in the European periphery at the time was worth considering; for example T.A. Edison (seven patents), A. Krupp (six patents), H.S. Maxim (13 patents – the highest number registered by one patentee) and G. Westinghouse jr. (six patents). These inventors applied for patents in their own names, but clearly they cannot be labeled as amateur inventors – they were indeed among the most well respected and well known inventors at the time.

The selections (patentees with more than four patents) in Appendix I and II will most likely have a bias towards professional inventors as compared to the entire number of patentees. But clearly, also amateur inventors could hold many patents. A distinction in addition to the actual number of patents may therefore be the degree of concentration of the patents in certain areas. According to Dutton, the professional inventor would spread the inventive effort and accordingly the patents on many areas - to diversify the portfolio and spread risk. This may well be the case for some inventors. We will, however, argue that the opposite may also be a likely strategy, that the professional inventor would concentrate his inventive efforts *within* his professional area (wood processing, machinery,

[13] I. Flood, *Slekten Steenstrup*, Oslo (unpubl.) 1961, p. 52ff.

navigation, etc). The amateur, on the other hand, may display no clear concentration or focus on certain areas. Our data seem to suggest such patterns. We can see that in Appendix I where a majority of the patentees that we know little about, held patents in a variety of fields (misc.). One example is Lars Engebretsen who held eight patents; a breadknife, a wood chopping machine, a ventilation oven, a cloth-iron, a system for heating of railway cabins, an apparatus of drying of whale meat, operation of a steam engine and a steam engine. These dispersed interests probably characterize a true amateur inventor. On the other hand, the more well known multiple patentees with a clear association to industrial firms, typically held patents within their fields of expertise.

We are not at this point going into detail on patenting from 1885 and onwards.[14] But a brief look at the patent records in the period until World War I reveals that individuals still dominated the records. However, among the most active Norwegian patentees, there was nevertheless a strong industry-connection. Some examples illustrate the pattern: Fr.V.L. Hiorth held patents on turbines and was well known for his contributions to the development of this technology. He had a leading role in re-organizing Kvaerner Brug in the 1890s and was involved in a number of other companies. His son, Albert Hiorth, patented particularly in the area of electro-metallurgy. He founded the Jøssingfjord Manufacturing Co A/S and ran an engineering consulting firm together with his father. W. Fougner held patents on turbines and was employed with Thune Works. Another engineer and patentee within this environment was G. Sundby – later professor in the field of turbine technology at the Norwegian Institute of Technology (NTH). E. Mortensrud held patents on cellulose processing and was a leading expert in the field. He held a senior management position at Kvaerner Brug. Another patentee in this field was D. Westad who, for a number of years, was the manager of Embretsfos Tresliperi (wood processing). Kr. Birkeland, who was responsible for the scientific and technological breakthroughs that led to the foundation of Norsk Hydro in 1904, was a very active patentee within the area of electro-technology. In the year 1908 alone, 13 patents were granted in his name. Dr. E. Collett also deserves mentioning here. He had studied together with Norsk Hydro founder Sam Eyde in Germany, and worked with Hydro and several other companies and patented within the field of chemistry. One last example is Axel Krefting. He had four patents in 1900 (the highest number that year) on industrial utilization of seaweed. He was undertaking scientific

[14] As can be seen in Figure 1 patenting in Norway increased substantially towards the turn of the century. In fact, about 9,000 patents were granted between 1885 and 1900. These data deserve a separate, in depth analysis.

nvestigations in this field and also founded companies at home and abroad. He was also a leading member of the Norwegian business community at the time.[15]

As was the case with patents granted to Norwegians, patents granted to foreign citizens were for many years mostly granted to individuals. It is difficult to assess the industry affiliation for many of these patentees and to what extent they should be characterized as amateurs or professionals. But clearly, as we have tried to show, many had strong links to industry.

As with the Norwegian patentees, the habits of the foreign patentees also changed. It probably occurred earlier among the foreigners patenting in Norway. In Table 3 we have listed the most active foreign patentees in Norway in 1900.

Table 3: Foreign patentees with more than four patents in Norway, 1900

Name and county of origin	*Patents*
B.G. Lamme, USA	16
F. Krupp, Germany	15
Allgemeine Electricitäts Gesellschaft, Germany	10
Siemens & Halske, Germany	7
Vågsfabriks Aktiebolag, Sweden	6
The Vacuum Brake Co. Ltd, UK	6
Armstrong, Withworth Co. Ltd, UK	6
E.B. Koopmann, UK	5
The Johnston Foreign Patents, UK	5
W. Healy, USA	4
F. Rosenberg, Germany	4
A.Schmidt, Germany	4

Source: *Register over norske patenter meddelt i 1900* (Register of Norwegian patents)

[15] The patentees are portrayed in several sources: *Norsk Biografisk Leksikon* (Norwegian Biographical Encyclopedia), *Universitetsbibliotekets utklippsarkiv* (the newspaper clip archive at the University Library), Oslo. See also M. Leegaard (ed.), *NIF 50 år*, Kra. 1924, Kr. Anker Olsen, *Kværner Brug gjennom 100 år*, Oslo 1953, A. Brodersen (ed.), *Industri og forskning*, Oslo 1938, K. Fasting, *Teknikk og samfunn*, Oslo 1952, E.Munthe Kaas (ed.), *Om jern og hjul og drivende krefter. A.S Thunes mekaniske Værksted til 150-årsdagen 7. september 1965*, Oslo 1965.

They are now clearly dominated by large, well known firms like Krupp, AEG and Siemens. However, the habit of patenting in the name of the individual inventor is still evident. The name on the top of the list is in fact Benjamin G. Lamme, the well known electrical engineer within the field of electrical power machines who had worked with Westinghouse for his entire career and became the chief engineer of the company in 1904. He held a number of patents, and was clearly no amateur inventor. His interest for patent-protection in Norway was shared with many other foreign inventors. Norway was about to embark on its hydro-electricity bonanza, and Lamme together with Westinghouse had just constructed the generators for the largest hydro-power plant in the world at Niagara Falls.

This listing will not be taken any further. More names could have been mentioned, but the point is just to illustrate that the patent system was not primarily used by those on the sideline of the industrial environment, but was always an integral part of research, development and innovation within industry. These patentees were obviously not amateur inventors, but professionals with formal ties to leading manufacturing firms within fields that were in the technological 'hot' areas at the time in Norway; such as wood processing, hydro electricity, electro-metallurgy and electro-chemicals. However, the habit of the day was that the inventor rather than the firm held the patent. This is clearly shown in our analysis.

In addition to some company patentees, there are also some few examples in the patent records of patents granted in the name of a company *as well as* one or more individuals. This probably indicates what may be termed as a transition practice in the way companies registered their patents. One example is the aforementioned patent granted to Christiana Spiger- og Valtseværk in 1855. The patent document itself stated that the patent was granted to the partners of the said company.[16] There are other variations of such combinations: A patent granted in 1872 was in the name of two individuals *on behalf of* (for) a company. A patent granted in 1873 was in the name of an individual *and* a company.[17] George Westinghouse jr. (Appendix II) had six patents in his name (between 1874 and 1884), but one patent from 1885 was also granted in the name of Westinghouse Brake Co. Ltd.

The habits of corporate patenting seem to have changed significantly only after the turn of the century when the company *names* gradually became much more apparent in the patent records. This

[16] The published text reads "Ved høieste Resolution af 19de September 1855 er der meddelt Interessentene i Christiania Spiger- og Valtseværk, Oluf Onsum, Ludvigsen & Schjeldrup, Jacob Woxen og Johan Danelius, Patent indtil 1ste Juli 1865 på…" *(..granted to the partners of Christiania Spiger- og Valtseværk, Olaf Onsum,…..*). *Polyteknisk Tidsskrift*, 1861, p. 186.

[17] 'C.E. Petersen og C.F. Ritter for Kristiania fyrstikkfabrikk' (1872); 'J. Person og Bryns fyrstikkfabrikk' (1872).

shift may be associated with changes in company organization and legislation. The limited companies became much more common at this time, and the relationship between company and employees were changed. In 1920 the share of patents granted in the name of companies had risen to about 27 percent, and in 1978 – to take a longer perspective - to 63.5 percent.[18] Compared with the major industrialized countries, the transition from individual patentees to company patentees was late in Norway. In the US, for example, about 50 percent of the patents were in the names of companies in 1930.[19] This level was reached in Norway only about 1955.

The numbers presented above have been extracted by studying the names of patentees in the patent records. There are, however, several possible sources of errors in this approach. Most importantly, there was a change in practice over the years as to in whose name a patent that originated within a company was applied for; the company itself or the employee who was responsible for the invention. The Norwegian practice was that the question was up for negotiation between the parties. Bryn states in his classic book on the Norwegian patent legislation from 1938 that as many as about 90 percent of all Norwegian patents up to that time were inventions made by employees.[20] Bryn does not reveal the data on which the calculation is based, but the number at least indicates that one should be careful in making estimates based only on the names in the patent records.

4. Conclusions

This paper has explored Norwegian patents in the 19th century. The main purpose has been to investigate the background of the patentees; whether they were mainly amateurs or rather professional inventors. One way to analyze this question is to distinguish between patents granted to individuals and companies.

Our analysis reveals that such a distinction is not very useful. The large majority of Norwegian 19th century patentees were individuals. Nevertheless, we find a strong association with industry and indeed the professional environment. Studying the multiple patentees, a category of patentees that has been termed 'quasi-professional inventors', we also find that they almost without exception

[18] Basberg (1985).

[19] Anderson, *op.cit*., Taylor and Silbertson, *op.cit.* See also Nicholas, *op.cit.* (2010), p. 58.

[20] A.B. Bryn, *Patentloven med kommentarer*, Oslo 1938, p. 163.

were individual inventors. This related both Norwegian inventors and foreigners that patented in Norway.

This study has not analysed every patent in the period in detail. Among the individual patentees, there were undoubtedly large numbers that truly should be categorized as amateurs. However, the study does show that the 19th century Norwegian patentees cannot be characterized in that way in general terms. There was always an interest from the professional business and industry environment. Patenting and the patent institution was, indeed, an integral part of 19th century economic life – not an oddity disconnected from it.

APPENDIX I: Norwegian patentees with four or more patents between 1840 and 1885

Name	*Number of patents*	*Specification / Industry*	*Background*
Jørgen Braadland	4	Farming equipment	(1843-1923) Farmer, known for inventions relating farming equipment, for example a harrow that was named after him ('Braalands rullehorv')
Hans Dahl	4	Sawmill machinery	n.d.
Lars Engebretsen	8	Misc.	n.d.
Ole Flagstad	6	Misc.	n.d.
Svend Foyn	5	Whaling	(1809-1894) The main inventor and entrepreneur of the so called modern whaling era from the 1860s.
H.C. Hansen	4	Wood processing	Millmaster. Established together with his brother the first wood processing mill in Skien, worked with Laugstol Brug and also led the work with establishing the first electricity work there in 1885.
Jacob Smith Jarmann	5	Rifles	(1816-1894) Engineer and rifle constructor. Established Nyland Mechanical Works in 1854 with P. Nørbeck, and was the manager there until 1881 when he became fulltime inventor.
G. Jensen	4	Misc.	n.d.
J. and A. Jensen & K. Dahl	4	Sawmill machinery	The brothers Jens (1817-1890) and Andreas (1821-1874) together with Knud Dahl (1823-1894) had the company 'Jajod' which later became Myren Mechanical Works, was from the start very active in patenting inventions within sawmill and other mill technology.
Ole Krag	5	Rifles, machine guns	(1837-1916) Officer and weapons designer. Head of Kongsberg Våpenfabrikk and responsible (together with Erik Jørgensen) for the most well known Norwegian rifle design.
Hans Larsen	12	Rifles	(1823-1907) Rifle constructor. Owned a handgun workshop in Drammen from 1845 and Kristiania from 1876. A very active inventor who had altogether 21 patents in Norway and 6 abroad.

Anton Løvstad	6	Misc.	(1838 ? -) Engineer. In charge of the building of the first sulfit cellulose plant in Norway; Vadretta in Skien in 1881. His patents were in several areas including wood processing.
G. Norseng	5	Carriole-design	n.d.
Johan Olsen	5	Misc.	Carpenter from Bergen.
O.M. Olsen	5	Misc.	n.d.
Christian Collett Steenstrup	4	Misc.	(1815-1876) Works master. Manager among others of Bærums Verk and Horten Mechanical Works. Was awarded for his inventions at several international exhibitions.
Henrik Chr. F. Størmer	4	Wood processing	(1839-1900) Engineer. An industrial pioneer in several areas, especially within paper, pulp and cellulose. Master at Myren from 1860 and founded several factories, among others Hafslund Cellulose Factory. Held altogether 15 patents mostly relating cellulose processing.
Ferdinand John Wedel-Jarlsberg	6	Navigation	(1828-1904) Baron and navy officer. His patents were related to compasses and navigational instruments.
C. Østlund	4	Boiling apparatus	n.d.

Source: The patent data: *Register over norske patenter udferdigede indtil 1ste Januar 1886* (Register of Norwegian patents), Kristiania 1896. The biographical data: Several of the patentees are portrayed in *Norsk Biografisk Leksikon* (Norwegian Biographical Encyclopedia). Another source is *Universitetsbibliotekets utklippsarkiv* (the newspaper clip archive at the University Library), Oslo. See also several company and institution histories; Chr. Gierløff, *Et bruk ved Akerselven, Myrens Verksteds hundre års minne*, Oslo 1948, G. Brochmann, *Jern*, Oslo 1939, M. Leegaard (ed.), *NIF 50 år*, Kra. 1924, Kr. Anker Olsen, *Kværner Brug gjennom 100 år*, Oslo 1953.

APPENDIX II: Foreign patentees in Norway with four or more patents between 1840 and 1885

Name	*Number of patents*	*Specification / Industry*	*Background*
Louis Bertol	4	Mill etc	n.d.
Thomas A. Edison	4	Electric lighting, Telephone, phonograph	(1847-1931) U.S. inventor responsible for decisive contributions to the development of electric lighting, the phonograph etc. Registered more than 1000 patents.
Anker Heegaard	4	Stoves etc	(1815-1893) Danish industrialist. Owned and managed iron foundries that manufactured stoves and several other products. He was also well known in the Danish business community.
Benjamin Barkley Hotchkiss	6	Guns, armory	(1826-1885) U.S. engineer and inventor. Known for his development of early machine guns. Moved to France in 1867 were he established a munitions factory.
Oscar F. Jønsson	4	Electric apparatus, dynamo	n.d.
Alfred Krupp	6	Railroad wheel, canon, projectile	(1812-1887) German industrialist and head of the Krupp corporation. Improved steel making processes that led to the development of among others new, high quality railroad wheels and canons.
Wilhelm Lorenz	8	Munitions	(1842-1926) German industrialist, munitions manufacturer and machine designer.
Hiram Stevens Maxim	13	Electric lamps and apparatus	(1840-1916) U.S. born inventor with contributions in several fields. His system of electric lights was the first to be installed in New York City, and he had several patent disputes with Edison. After moving to the UK he invented a machine gun that was widely used. He also contributed inventions about aviation.
Nicolaus A. Otto	4	Gas engines	(1832-1891) German engineer and inventor especially known for the development of the four-stroke engine that became decisive for

			later automobile design.
Julius Pintsch	4	Gas lighting for light houses	(1815-1884) German manufacturer and inventor, especially known for the invention of the gas meter and a long-burning gas that could be used during motions (in trains and at sea). Manufactured gas-related devices.
William Robert Rowan	6	Railroad equipment	English engineer.
George Sebold	6	Match manufacturing	n.d.
George Westinghouse jr.	5	Railroad braking system	(1846-1914) U.S. engineer and industrialist. He made a significant invention regarding a railway air brake system that was widely used. He also invented within the field of electricity and was considered one of Edison's main rivals.

Source: The patent data: *Register over norske patenter udferdigede indtil 1ste Januar 1886* (Register of Norwegian patents), Kristiania 1896. The biographical data: Various encyclopedias and dictionaries and web-based biographies.

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